Contents

List of figures  page  viii
List of tables  x
Preface  xiii

1 Introduction  1
1.1 Problems, policy and management of wetlands  1
1.2 What are wetlands?  3
1.3 Wetlands in the Netherlands  5
1.4 Wetland research  8
1.5 Scope and objectives  10
1.6 Outline of the book  13

2 Wetlands and science  15
2.1 Introduction  15
2.2 Hydrology and ecology  15
2.3 Environmental and ecological economics  36
2.4 Natural-social science integration  49
2.5 Conclusions  53

3 Integrated modelling and assessment  55
3.1 Introduction  55
3.2 Integrated modelling  57
3.3 Spatial modelling  62
3.4 Integrated modelling and monetary valuation  69
3.5 Performance indicators  75
3.6 Evaluation 80
3.7 Conclusions 81

4 Theoretical framework and method of integrated study 83
4.1 Objective and approach 83
4.2 Three integration levels 85
4.3 Spatial dimension 87
4.4 Relevance for policy and management 88

5 The Vecht area: history, problems and policy 89
5.1 Description of the area 89
5.2 Historical development of the area 90
5.3 Threats to the wetlands 96
5.4 Economic activities 98
5.5 Policy and management in the Vecht area 99
5.6 Conclusions 104

6 Development scenarios for the Vecht area 106
6.1 Introduction 106
6.2 Scenario I: reference 109
6.3 Scenario II: stimulation of agriculture (Agriculture scenario) 109
6.4 Scenario III: stimulation of nature (Nature scenario) 110
6.5 Scenario IV: stimulation of recreation (Recreation scenario) 112
6.6 Conclusions 114
Appendix 6.1 List of polders 114

7 The spatial–ecological model: hydrology and ecology 116
7.1 Introduction 116
7.2 The hydrological quantity model 117
7.3 The hydrological quality model 121
7.4 The ecological model 123
7.5 Modelling results 126

8 The spatial–economic model: agriculture, nature conservation and outdoor recreation 129
8.1 Introduction 129
8.2 Environmental and economic data 131
8.3 Modelling results under the three scenarios 137
8.4 Economic benefits of nature and recreation 143
8.5 Summary of modelling results 146
Appendix 8.1 Calculation of economic and nutrient variables under the Agriculture scenario 148
Contents vii

Appendix 8.2 Outdoor recreation data 150
Appendix 8.3 Economic scenario results on a polder level 152

9 Performance indicators for the evaluation 162
  9.1 Introduction 162
  9.2 Performance indicators for environmental quality 163
  9.3 Performance indicators for spatial equity 177
  9.4 Conclusions 181
  Appendix 9.1 Full list of species identified 182
  Appendix 9.2 Environmental quality and economic welfare indices on a polder level 187

10 Evaluation of the scenarios 194
  10.1 Introduction 194
  10.2 Point evaluation 194
  10.3 Spatial evaluation 199
  10.4 Conclusions 204

11 Conclusions: policy and research implications 207
  11.1 Purpose 207
  11.2 Method of integrated research 207
  11.3 Natural science modelling and results 208
  11.4 Economic analysis and results 209
  11.5 Indicators, spatial evaluation and scenario ranking 211
  11.6 Further research 212

References 214
Index 234